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STATEMENT ON THE SCIENCE AND TECHNOLOGY PROGRAM AND THE ROLE OF DEPARTMENT OF DEFENSE LABORATORIES

FY 1979,

BY

DR. RUTH M. DAVIS
DEPUTY UNDER SECRETARY OF DEFENSE FOR
RESEARCH AND ADVANCED TECHNOLOGY

BEFORE THE

FOSSIL AND NUCLEAR ENERGY RESEARCH,
DEVELOPMENT AND DEMONSTRATION SUBCOMMITTEE

OF THE

SCIENCE AND TECHNOLOGY COMMITTEE

OF THE

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THE DEPARTMENT OF DEFENSE
SCIENCE AND TECHNOLOGY PROGRAM AND THE
ROLE OF DEPARTMENT OF DEFENSE LABORATORIES
FY 1979
Statement by
Dr. Ruth M. Davis
Deputy Under Secretary of Defense for
Research and Advanced Technology
To the
Subcommittee on Fossil and Nuclear Energy
Research, Development, and Demonstration
Of the
Committee on Science and Technology
House of Representatives, 95th Congress, Second Session
16 May 1978

Mr. Chairman and Members of the Committee,

One of our nation's greatest strengths is its sustained scientific and technological vigor. This national strength is key to our continuing national security as it is to the performance advantage of U.S. military forces and weapons systems, and the technological advantage of U.S. military R&D capabilities over potential adversaries. The Department of Defense (DoD) Science and Technology Program provides the foundation for such military technological superiority. It is the source of the ideas and inventiveness which lead to new weapons systems, to the improvement of existing systems and to the integration of disparate development and equipment units into the coherent systems which underlie our military strength.

The DoD Science and Technology Program covers the spectrum of critical military technologies from munitions, guidance and control

and electronics through materials, mathematics and physics, through oceanographic and environmental sciences to chemical and biological defense and to the vital areas of training, safety, food and life sciences.

The DoD Science and Technology Program includes efforts in the areas of Research, Exploratory Development and Advanced Technology Demonstrations. For management purposes, the program is divided into 24 separate technical areas (such as aircraft propulsion, electronic warfare and environmental sciences) ~~as shown in Figure 1~~ and grouped into 3 major components; namely, Engineering Technology, Electronics and Physical Sciences and Environmental and Life Sciences.

The work is performed by a combination of 78 in-house research and development activities, 150-175 universities and a wide segment of industry. The total program budget request is approximately $2.6 billion in FY 1979.

A. PARTICIPATING IN THE SCIENCE AND TECHNOLOGY PROGRAM

In FY 1977, in the DoD Research Program (about 18 percent of the Science and Technology Program), some 40 percent of the work was carried out by DoD in-house laboratories, 40 percent by universities and 20 percent by industry and nonprofit organizations. As would be expected, this program balance shifts increasingly from universities through the DoD laboratories to industry during the progression from Research through Exploratory Development to the Advanced Technology Demonstration

Figure 1

The Technology Areas of the DoD
Science and Technology Program with Associated Funding
(Dollars in Millions)

Technology Area	FY 77	FY 78	FY 79
Propulsion for Missiles and Space	46	52	66
Aeronautical Vehicle	106	108	113
Aircraft Propulsion	93	99	113
Guided Missiles and Rockets	76	78	99
Guns	79	85	94
Torpedoes and other Underseas Warfare Weaponry	23	19	21
Landmines, Landmine Countermeasures and Barriers	13	18	18
Ocean Vehicles	114	118	138
Land Mobility	26	26	47
Materials and Structures	114	121	129
Bombs and Clusters	11	10	11
Research	338	370	419
Electronic Devices	59	62	68
Electronic Warfare	46	55	63
Search	90	93	99
Target Exploitation	34	38	28
Command and Control	44	45	57
Communications	14	16	19
Information Processing	19	17	22
Medicine and Life Sciences	116	126	141
Training and Personnel	82	91	103
Environmental Quality Research and Development	33	29	32
Environmental Sciences	122	139	146
Chemical Warfare and Chemical-Biological Defense Research and Development	39	37	50
TOTAL	1737	1852	2096

component of the Science and Technology Program. In the latter program, about 70 percent is carried out by industry and 30 percent by DoD laboratories. The in-house laboratories' principal area of participation is in exploratory development.

A strong contract program is important to the Science and Technology Program and to the effective transfer of new technology to system development. Reasons for this include:

- The U.S. is committed to using industry as the prime source for the development and production of almost all new military hardware. The technology transfer problem is therefore facilitated if much of the technology is developed in industry in the first place.
- Industry has particularly high technology skills in certain areas and large investments in special facilities that we cannot afford to duplicate in-house, e.g., for the production of solid state electronic devices and systems and for precision machinery, such as gas turbines.
- Our well-spring of effort in the fundamental sciences is academia, and we rely on academia for many of our basic advances.

On the other hand, a healthy DoD laboratory system is a necessity. In areas of limited industrial or academic interest, such as explosives research, explosive ordnance disposal technology, and chemical warfare, the DoD laboratories are virtually our sole source of expertise and

certainly our best source. Second, even though we must often turn to industry for fabrication of experimental devices and apparatus, it is often appropriate and highly desirable to have the experimentation, testing and evaluation done in whole or in part in the DoD laboratories and to use their familiarity with Service problems to decide in what direction the technology should be pushed. It is often necessary to do the testing there, since many of our labs have unique test facilities. Lastly, in order to be smart technical buyers, we must maintain a cadre of people with state-of-the-art knowledge who do not have commercial allegiances and who can provide a quick response to urgent DoD problems. This cadre must be reasonably permanent to provide a corporate memory of past problems, successes and failures and to preclude repeating previous mistakes. We feel the best way to achieve this is via an active and technologically involved in-house RDT&E community staffed by career people. To maintain their skills and to command the respect of our contractors, they must personally be involved in technology.

The performer distribution of the DoD Research, Development, Test and Evaluation (RDT&E) Program is estimated to be as follows:

RDT&E BY TYPE OF PERFORMER
($ in Millions)

Performer	FY 1977	FY 1978	FY 1979	FY 1980
Industry	7,258.8	7,920.6	8,664.9	10,101.3
Government In-House	2,832.5	2,969.0	3,176.8	3,417.1
Federal Contract Research Centers (FCRC)	190.8	198.6	230.2	261.5
Universities	306.0	324.4	396.1	418.8
Total RDT&E	10,588.1	11,412.6	12,468.0	14,198.7

As you can see, the DoD depends heavily on the private sector to provide the products and services that ultimately make up the defense forces of the country. Within the FY 1979 request of $12.5 billion for DoD RDT&E, approximately $2.6 billion is for the Science and Technology Program. The Science and Technology Program performer distribution is, as I indicated earlier, oriented more toward in-house performance as follows:

	Performed In-House (Percentage)	
Service	FY 1975	FY 1977
Army	66	56
Navy	45	38
Air Force	42	42
Total	42	37

You will note that there has been a shift in science and technology performance, in a percentage sense, from the in-house activities to the private sector. This resulted from a Department conclusion in 1974 that there should be a reversal of the trend toward performing an overwhelming portion of the Science and Technology Program in-house. However, it was not considered prudent to return to decade past levels but rather accept an intermediate level of 35 percent in-house by each Military Department. This would preclude major disruptions and would recognize specialized areas where industry does not maintain a strong technology capability. It was anticipated that when Military Department Science and Technology Program activity was combined with similar Defense Agency activity, the overall in-house level would be approximately 30 percent.

The direction concerning the level of in-house Technology Base activity was applied at the overall Military Department level and did not establish minimum goals for any defense research installation within the Military Departments. This provided the Military Departments with maximum flexibility while achieving this goal.

As a step toward implementing this goal, in 1975, the Office of the Secretary of Defense directed that certain manpower reductions be taken in the RDT&E Program. The manpower drawdowns which were agreed to by the Services were as follows: Army 2900, Navy 3000 and Air Force 1000. The end-strength 1974 was the base from which the drawdown would be taken, and the drawdown was to be completed by the end of FY 1978. The manpower strengths (in thousands) in the RDT&E Program are as follows:

	FY 1974 Actual	FY 1977 Actual	FY 1978 Planned	FY 1979 Planned
Army	25.2	23.2	23.0	23.1
Navy	39.5	35.9	34.6	32.3
Air Force	21.7	18.7	18.8	18.1
Total	86.4	77.8	76.4	73.5

Subsequent events in DoD led to greater reductions than the original 6900 that were "directed". These reductions in RDT&E, in my view, have reduced the percentage of RDT&E performed in-house. There was also, of course, substantial funding increase in the Science and Technology Program over this period because of the recognition by OSD and the Congress that a strong Science and Technology Program was essential to long-term interests of national security.

The measurement of the effects of our current performer distribution is difficult to quantify and the time span since implementation has not been sufficient to make valid observations as to the productivity of the shift toward the private sector. However, I am aware that this shift has created concern on the part of personnel within our laboratory system as to the long-range role of DoD in-house laboratories.

The distribution of work between DoD laboratories, industry and academia is affected by a number of factors such as the past history of in-house laboratory achievements, the available industrial vs. laboratory capability in any one technical area (e.g., large caliber guns as contrasted with aeronautical propulsion) and, to an extent, the breadth of the commercial base of technology (aeronautical propulsion).

B. DOD SCIENCE AND TECHNOLOGY PROGRAM RESPONSIBILITY AS RELATED TO DOD LABORATORIES

As noted earlier, the DoD Science and Technology Program objectives are to advance the state-of-the-art in a broad spectrum of technologies which are applicable to future military needs and prevent technological surprise. The program is balanced between near and long-term projects in order to maintain our technological superiority over potential adversaries.

The Office of the Secretary of Defense interprets Administration policy and provides general overall force, programmatic and fiscal guidance to the Military Departments. The Military Departments are

responsible for program planning and, after Office of the Secretary of Defense review and Congressional appropriation, for program execution. Within the Military Departments and Defense Agencies, the Headquarters staffs:

- o Communicate and prioritize needs
- o Formulate policies and investment strategies
- o Review performance, and
- o Monitor laboratory/contractor interfaces

The in-house RDT&E activities as DoD mission elements are responsible for:

- o Support to Program Managers involved in system development and acquisition, and
- o Maintenance of the Science and Technology Program in their area by:
  - Performing program planning
  - Performing the in-house work
  - Defining and supervising contract efforts

Flexibility is provided in the system by establishing appropriate levels of funding reprogramming authority at various management levels. For example, the Military Departments have authority under most conditions to reprogram up to $2 million into program elements within their RDT&E programs. The level of reprogramming authority at each laboratory is a function of the size of the laboratory and the diversity of its technical program.

The in-house laboratories have several major sources of funds: (1) those from their Headquarters which are applied to the Science and Technology Program and other Departments and (2) those for which they are reimbursed for work performed for program development and acquisition offices. The former work is primarily aimed at furthering technology in a particular area while the latter emphasizes concept formulation, design studies, acquisition support and testing and evaluation of components and systems. Generally, the DoD laboratories as a group receive approximately 40-45 percent of their funding from the Science and Technology Program.

C. DOD LABORATORIES AND THEIR PRIMARY RESPONSIBILITIES

The structure of the in-house RDT&E organizations varies from full spectrum military platform (missiles, underseas warfare) oriented organizations performing all categories of RDT&E to technology (avionics, aeronautical propulsion) laboratories whose work is oriented heavily toward the Science and Technology Program. Very high risk but high payoff RDT&E requiring management directly from the Office of the Secretary of Defense is generally done by the Defense Advanced Research Projects Agency (DARPA) which accomplishes its mission, again, primarily through the in-house laboratory structure. The predominance of system engineering and technical direction (SE/TD) support to prototype engineering, system development and other acquisition functions is performed by in-house DoD activities. Overall, this arrangement gives the Department efficient and effective technical

management and good technology transfer from ideas to product. It also is consistent with the goals of OMB Circular A-109 on Major System Acquisitions.

Circular A-109 recognizes the need on a government-wide basis, and specifically within DoD, for a strong Science and Technology Program to provide the options for meeting future mission needs of the agencies involved. The DoD laboratories have the principal responsibility for formulating a broad-based program attuned to our long-range mission deficiencies, performing a portion of the required research and development and providing the government/private interface for that portion which they do not perform. The resulting Science and Technology products place the Department of Defense in a position to proceed in the major system acquisition process under the guidelines of Circular A-109.

Using our Defense Systems Acquisition and Review Process, we find that the Mission Need Statement, or what we call Milestone O, Program Initiation, provides for more attention to strengthening the "front end" of the acquisition process so that proper management attention and visibility are focused before programmatic commitments are made. Our DoD laboratories are expected to provide increasingly more help to Program Managers in the evaluation of competing concepts. In addition to this role, we expect the laboratories to continue to participate in competitive development of system design concepts to the maximum extent possible. We are now working out details of how far

BRIEF BIOGRAPHY

RUTH M. DAVIS

Dr. Ruth M. Davis is Deputy Under Secretary of Defense for Research and Advanced Technology, Office of the Under Secretary for Research and Engineering, Office of the Secretary of Defense. Before coming to OSD, she was Director of the Institute for Computer Sciences and Technology of the Commerce Department's National Bureau of Standards. During her public service career, Dr. Davis has received many awards including the National Civil Service League Award in 1976, the Rockefeller Public Service Award for Professional Accomplishment and Leadership in 1973 and the Department of Commerce Gold Medal in 1972. She has also been elected to membership in the National Academy of Engineering and the National Academy of Public Administration. She serves on the Electric Power Research Institute Advisory Council, on the Board of Directors of the American Association for the Advancement of Science and on other scientific and technical advisory groups and councils. Dr. Davis received her B.A. degree from American University in 1950 and her M.A. and Ph.D. degrees in 1952 and 1955, both from the University of Maryland.

into our program development cycle they should participate. Our final process will have to ensure a flow of ideas to industry, because we do not intend to waste the valuable resources represented by our in-house laboratories.

As we proceed into the System Acquisition process, I would like to outline another important function of the laboratories. The Development Coordinating Paper (a major internal decision paper) requires at Milestone I, Demonstrations and Validation, and at Milestone II, Full Scale Engineering Development, a Technology Assessment Annex (TAA) that will identify any areas of technology risk remaining in the program and describe plans for addressing these risks. The TAA is prepared by the program manager, assisted by a laboratory or laboratories selected for this purpose. This function places substantial responsibility on the laboratories as it relates to major systems.

The basic functions of the laboratories have not changed dramatically over the past years. The Department periodically has made changes intended to provide better in-house support to DoD. Among these are:

- o Adjustment of the amount of work performed in-house (as discussed earlier).
- o The concentration on policy setting, prioritization and program assessment at the Headquarters levels.
- o The concentration of detailed management of the Science and Technology Program at the laboratory level by those closest to technology, and

- The use of "block" or institutional funding as part of a laboratory's budget in order that programs can be developed, for submittal to high headquarters, as perceived by the Laboratory Director.

D. TECHNOLOGY TRANSFER

Technology transfer from laboratory to fielded products in the defense community relies on a variety of steps. The private sector is the final developer and producer of practically all our equipment and systems. They also perform about 60 percent of the Science and Technology Program. This interaction on a day-to-day basis provides, in conjunction with good scientific and technical information (STINFO) clearinghouse services, what I believe is a practical and effective means of accomplishing the difficult process of technology transfer.

Another important step is the limitation we place on ourselves to pursue only projects and programs that have a potential relationship to a military function or operation. We are a mission agency and confine our activities to national security. Hence, technology transfer of importance to us is bounded in its scope.

Nevertheless, the products of military RDT&E do have great secondary or "spinoff" potential. We place the results of our RDT&E in the National Technical Information Service (NTIS) and the Smithsonian Science Information Exchange (SSIE) to make them readily available to the public. We are the major participant in the Federal Laboratory Consortium for Domestic Technology Transfer, which is an informal

grouping of Federal laboratories banded together to promote the application of technology developed in Federal laboratories to critical domestic problems.

And finally, technology transfer is made dramatically easier by the very fact that industry, the sector of our economy that can best effect technology transfer within the private sector is the major DoD RDT&E performer and ultimate producer of our products. You don't have to look far--to commercial aircraft, jet engines, calculators, for example--to see the spinoffs from DoD RDT&E.

E. CONCLUSIONS

The Under Secretary of Defense for Research and Engineering has indicated his desire to maintain strong and viable in-house research and development activities within the Department of Defense to provide needed research and development direction and technical support functions to DoD system development offices.

We do not allow ourselves to become complacent about the status quo of our in-house laboratories. We review our DoD laboratory program periodically to assess its products, its missions and its resident competency. We try to make realistic adjustments in the DoD laboratory program as dictated by changing technologies, defense requirements and other national considerations.

I have presented some highlights of our Science and Technology Program and our RDT&E organization. The Program is closely coordinated

with the Intelligence Community, DoD development organizations and operational commands. It is coupled with, and complementary to, the science and technology programs of the Departments of Energy and Transportation and of the National Oceanic and Atmospheric Administration and of the National Aeronautics and Space Administration. It relates well to similar programs pursued by our allies.

The Science and Technology Program is a highly selective mix of high-risk, high-impact projects, of incremental advances in technology, of anticipated technological breakthroughs and of low-risk but urgently needed research and development. It runs the gamut from academic research to advanced full-scale technology demonstrations in operational environments.

I have been pleased to present to you our Science and Technology Program and our DoD in-house participation in it. I will be pleased to answer any of your questions.

Attachment
Dr. R. M. Davis' biography